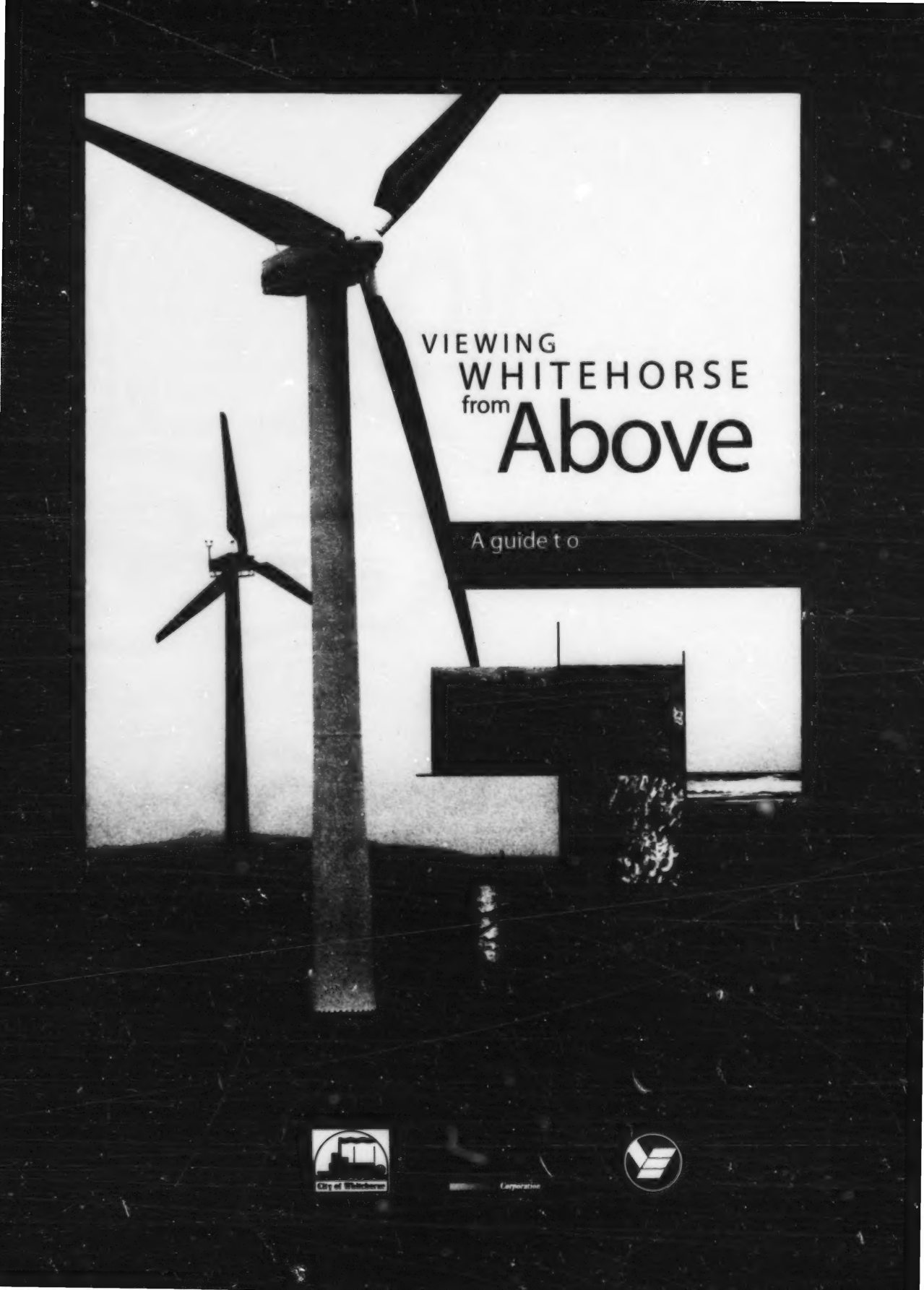
VIEWING
WHITEHORSE
from
Above
A guide t o

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This guide is provided by Yukon Energy as a community service. Every effort has been made to verify the information provided here. Any suggestions you have for inclusion in future printings are welcome. USE OF ACCESS ROAD AND AREA IS STRICTLY AT YOUR OWN RISK.

All photos by Peter Long, Boreal Alternate Energy Centre, Yukon Energy or Janne Hicklin.

One in a series of local guides. Also available: *Enjoying Whitehorse Trails* and *Exploring the Whitehorse Fishway*.

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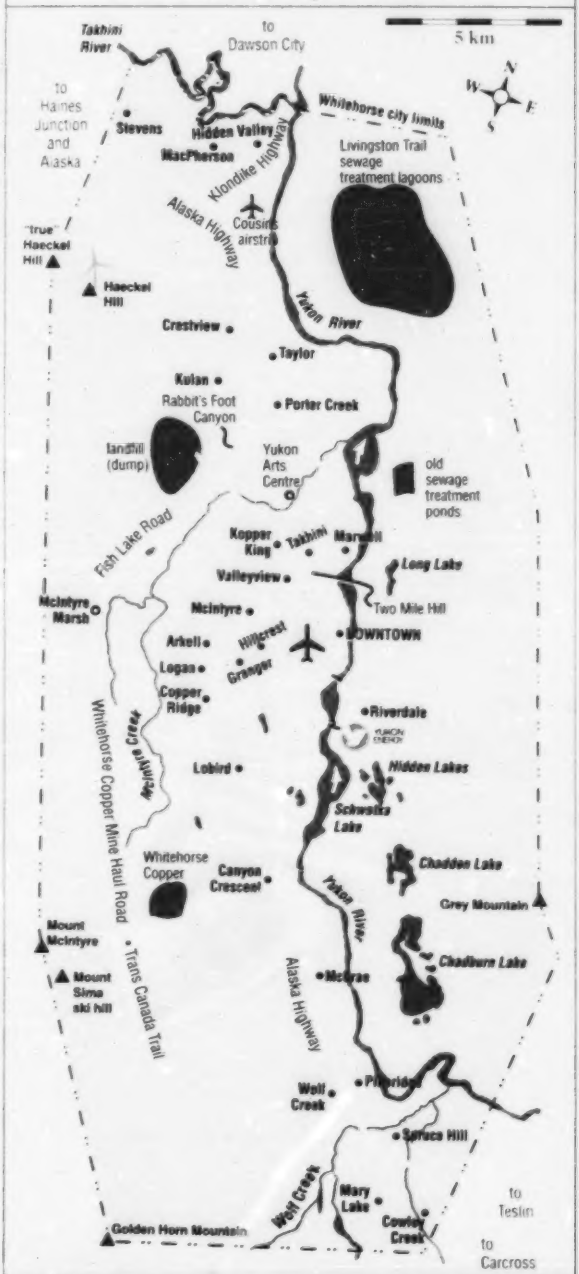
Overview of the City of Whitehorse



WARNING! The rough gravel road up Haeckel Hill is a public road but is not maintained. It is not suitable for long vehicles such as mobile homes, nor is it a winter road. Drive with extreme caution

Welcome to Haeckel Hill

Of all the mountain or hilltop viewpoints in the Whitehorse area, Haeckel Hill is one of the most noticeable. The two Yukon Energy wind turbines atop the hill make it a very distinctive landmark. At a height of 1,433 metres above sea level or about 800 metres above the Yukon River, this site offers an unusual opportunity to join the soaring eagles for a great birds'-eye view! Appropriately, the Southern Tutchone name for this height of land is *Thay T'äw*, meaning "eagle nest."

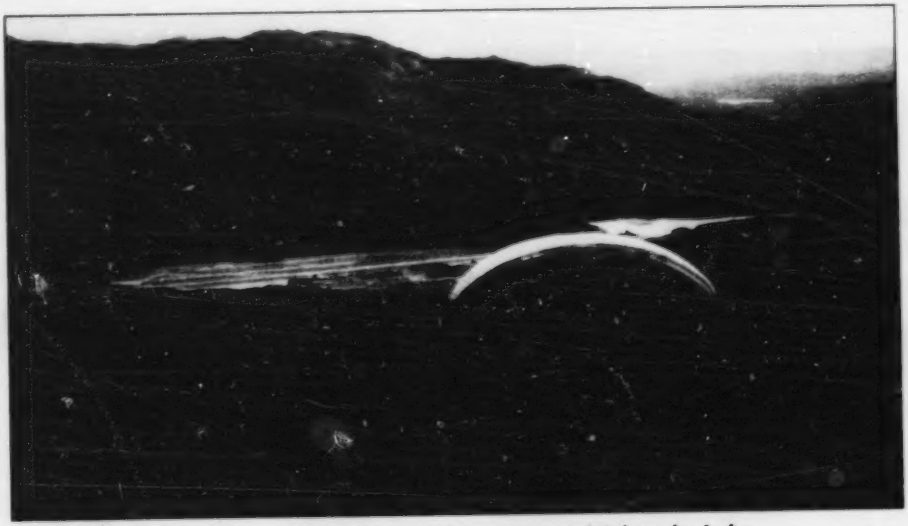
This booklet describes a part of the Sumanik Massif, the large hill which extends farther to the northwest of Haeckel Hill. In fact, the name "Haeckel Hill," adopted in the late 1800s after Ernst Haeckel, a renowned German ecologist, officially belongs to another hill which is part of this same massif. Once a road was pushed in for the fire tower, and sites were developed for telecommunications equipment and wind power generation, the name Haeckel Hill became attached instead to the highest point of land at the end of the road. The "true" Haeckel Hill forms one of the boundary markers for the Whitehorse city limits.

At the top of Haeckel Hill, you can crouch down to see the rocks and lichens, or stretch your view to distant mountain peaks. You can observe the results of geological processes that span over 200 million years. Change still occurs at rates so slow, it is difficult to notice.

Regardless of how much time you have, this guide will help make your outing more fun. It provides an overview of what you can see in four directions.

Use the maps (listed on opposite page) to orient yourself. Read the sections on wind turbines, geology, vegetation, wildlife and human history of the area.

For your safety, and to protect the very fragile alpine environment, please stay on the trails.



Looking east towards Grey Mountain, over the airport and Schwatka Lake.

Getting to the top

- Travel north on the Alaska Highway towards Haines Junction. Turn left onto the Fish Lake Road, 2.9 kilometres west of the Alaska Highway–Two Mile Hill intersection.

- Drive 3.4 kilometres. Turn right onto a dirt road at the four-way intersection marked by a large rock commemorating the Pueblo Mine disaster. (Or park at the McIntyre Marsh wildlife viewing site and walk up, about an hour.)

- Go past the private fish farm at the start of the dirt road. It is 6.5 kilometres from here to the top, about 15 minutes of slow driving on rough surfaces with occasional sharp turns. (Park off the road and walk up if it is too rough.)

- Near the top, the road widens considerably as you arrive at a flat, open area. Do not drive up either driveway as the barriers may be locked at any time. Instead, park off to the side, leaving room for service vehicles to get by.

- Walk up the left driveway and you will arrive at the base of two impressively large wind turbines.

Please respect the equipment!

At the south end of the hill is a piece of property owned by the Government of Canada. It contains microwave communications equipment, exposed electrical cable, a wind monitoring station, lightning detectors, RCMP communications equipment and a fire lookout station staffed from May through August. (Never disturb the fire-watcher!) Walking through or immediately below this area poses potential health and safety risks and may interfere with microwave transmission.

Just below the fire lookout is a dark-green pillar called a "comshell," a secure, weatherproof home for communications equipment. Down the hill and to the northeast of the fire lookout, an orange cylindrical structure contains equipment used for earthquake prediction and a receiver that tracks satellites to aid in precision mapping. This station, which links into other geodetic control stations, is a vital part of the Whitehorse survey system.

When to go

If the skies are clear, the view from the top is spectacular. Strong winds make Haeckel Hill a good site for harnessing wind power, but the combination of altitude and wind chill often means that in summer it is colder at the top than in town.

It is best to avoid the hill in winter. Ice that forms on the wind turbine blades is thrown off at high speeds and often lands far from the tower.

What to take

Bring warm clothes, including a wind-proof jacket and pants, hat and gloves. In July and August, wear long sleeves and pants as protection from bugs. Sometimes, a hat with mosquito netting is called for. Footwear should be suitable for rugged terrain; you will encounter jagged rocks, snow into the summer months and some wet, boggy areas.

You could also bring along any of the following: binoculars, camera, topographical map (105D Whitehorse), compass, magnifying glass, books on geology, alpine flowers and birds, and water and snacks.

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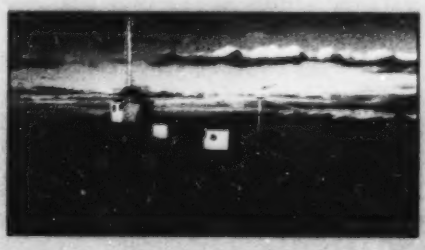

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Getting around

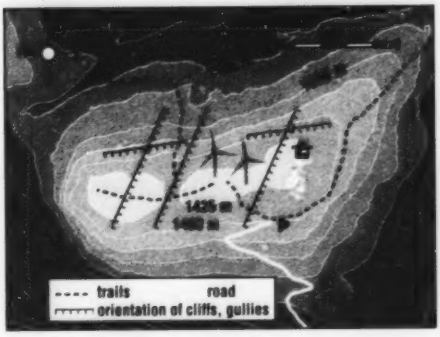
It is easy to spend several hours on Haeckel Hill, just wandering around, looking out at the spectacular views all around, listening to the endless whoosh of the turbine blades.

If it's sunny, you may notice the shadow of the blade tips going quickly past you like a strobe light. This is known as the "disco" effect and constant exposure to it can cause psychological discomfort.

As you look around, imagine yourself in a time long ago, following well-established trails east from Fish Lake along to the Yukon River, north to the Ibex, west to the Takhini River, or south towards Carcross. Although roads and other development have replaced or obliterated many of these routes, some original trails are still in use today.

South towards Fish Lake

Before walking up the path towards the wind turbines, look south from where you parked. The large body of water directly across the valley, at



1,000 metres, is Fish Lake. Louise Lake is in the foreground. At 2,088 metres, Mount Granger is one of the highest peaks in the area, just behind Fish Lake. On a clear day, the snow-capped peaks of the coastal range are visible in the distance to the west.

To the southeast, you can see features such as the Whitehorse Airport, the Alaska Highway winding south through the McCrae industrial area, and the Whitehorse Copper Mine Haul Road. Peaks that may help orient your view

Looking south towards Fish Lake, with Mount Granger in the background. Ice once filled this valley. Dashed lines mark glacial sediment left behind by melting glaciers retreating towards the mountains.

include Grey Mountain (officially known as Canyon Mountain), Golden Horn Mountain, Lorne Mountain, Mount McIntyre, and the ski slopes on Mount Sima. Note the large, brown scar left from a forest fire that threatened the Hamilton Boulevard-area subdivisions in the late 1990s.

North towards Lake Laberge

To fully appreciate the view north, you must walk right to the top, near the larger wind turbine. In front of you, the terrain drops down into a valley and up again to the long east-west ridge of Mount Sumanik.

Out in the broad Yukon River valley, look for the clay cliff banks flanking the winding Yukon and Takhini rivers. Note where the Takhini River flows into the Yukon River, which is heading north through Lake Laberge on its 3,000-kilometre journey to the Pacific Ocean. The long, straight stretch of road is the Klondike Highway, linking Whitehorse to Dawson City.

Echo Valley forest fire

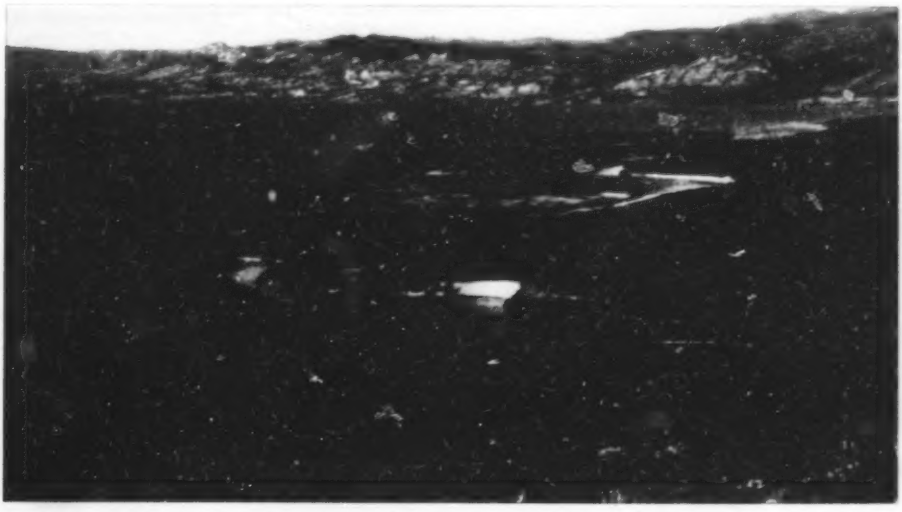
In 1991, a fire that started in a gravel pit in the Sumanik Massif area turned into a massive blaze which burned 1,500 hectares.

The fire travelled uphill and around the east side of the massif before firefighters contained it. A cut-line bulldozed up the hill successfully prevented it from spreading further. Look for that cut-line running vertically up the far side of the next valley. To the right of this line is a forest of standing burned trees and to the left, a living pine forest.

The influence of the wind gave the burn a sweeping fan shape, as seen from above. You can see the fire scar from both the Alaska and the Klondike highways.

West towards Mount Sumanik

For a leisurely one-hour stroll, follow a fairly visible, well-worn path starting to the west of the larger turbine. This path leads down across a shallow, fertile gully



Looking north towards Lake Laberge, note the clay cliffs lining the Yukon River which cuts through and washes away fine sediment deposited by an ancient glacial lake. The Klondike Highway can be seen near the left edge, after it crosses the Takhini River.

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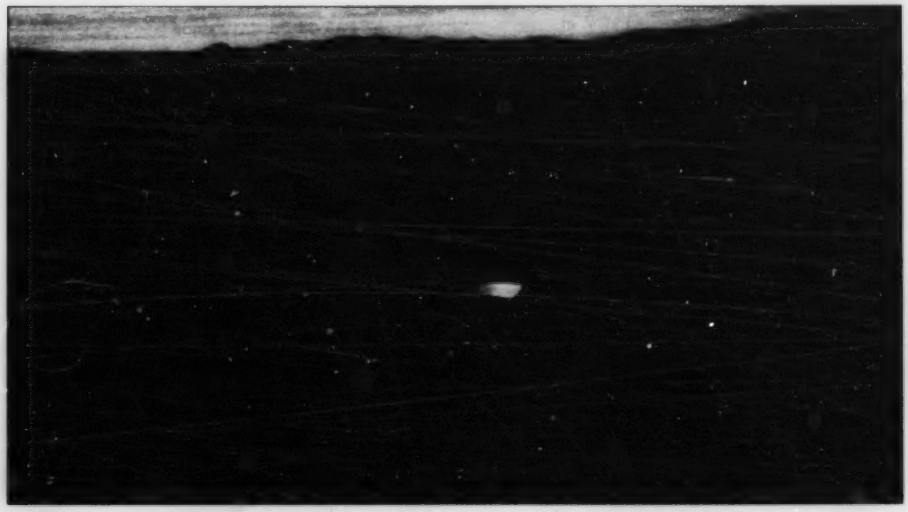

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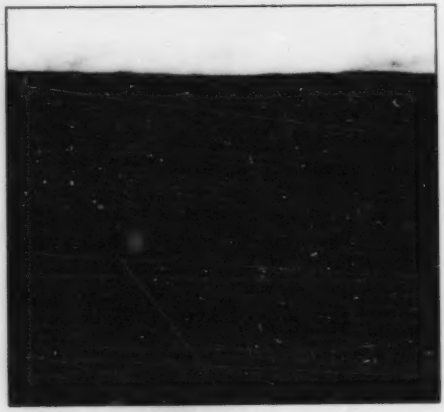


Looking west to Mount Sumanik. The valley on the left side faces east and is thick with dark green spruce, while the higher, south-facing hillside to the right is covered in pine.

and then up onto a rocky knoll. For a brief and intense few days in early July, this trail is an ideal spot to view alpine wildflowers in bloom.

The trail fades out as you approach the top of a steep, rocky cliff facing west, across a thickly vegetated valley, towards Mount Sumanik.

For the agile hiker, a clamber around the rocky rim to the north offers different perspectives on the geology of the hill.

East towards downtown

For a good view eastward, take the path toward the fire tower from where you parked until you reach the chain across the road. Beyond is private property. Cut right around the rim of the hill to the open ridge which heads east. Stay well below any equipment.

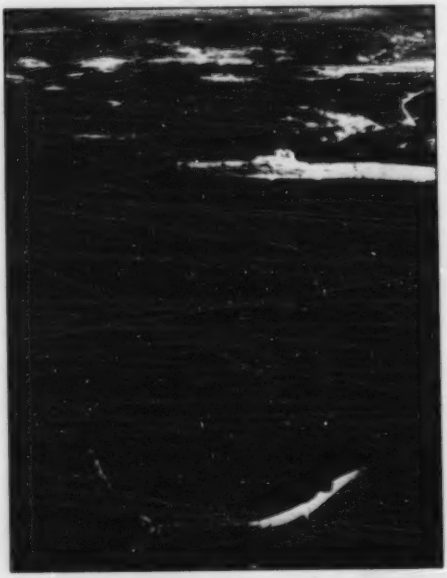
From here, head down the hill towards the river and the landfill site for a mix of great views, bushwhacking and easy hiking. Notice the stair-like nature of the hill.

The view encompasses most of the developed area in and around Whitehorse. The Whitehorse landfill, located in the mined-out pit of the War Eagle copper deposit, dominates the near view.

To the south, the Alaska Highway intersects Two Mile Hill, the north access into the city, and then passes by the airport. On the far side of the Yukon River, the Whitehorse sewage lagoon looks like a series of small lakes.

On the facing lower slope of Grey Mountain, you can trace the road upward to Northwestel's 91-metre and 38-metre microwave towers, about 20 kilometres away. If it is clear, Marsh Lake may be visible just around the south ridge of Grey Mountain. Near the base of Mount McIntyre, note the Mount Sima downhill ski trails and the abandoned Whitehorse Copper Mine tailings in the prominent open flat area.

The long ridge of Cap Mountain dominates the far side of the valley.



Looking east, with evidence of caribou in the foreground. The landfill and the Alaska Highway coming into Rabbit's Foot Canyon are visible in the background.

Day hike to Mount Sumanik

The nearest mountain to Haeckel Hill is Mount Sumanik, the broad ridge 268 metres higher to the west. It was named for Don Sumanik, a founder of the ski club and responsible for bringing the Nordic World Cup to Whitehorse in 1982. From the wind turbines on Haeckel Hill, you can walk to the top in four to five hours.

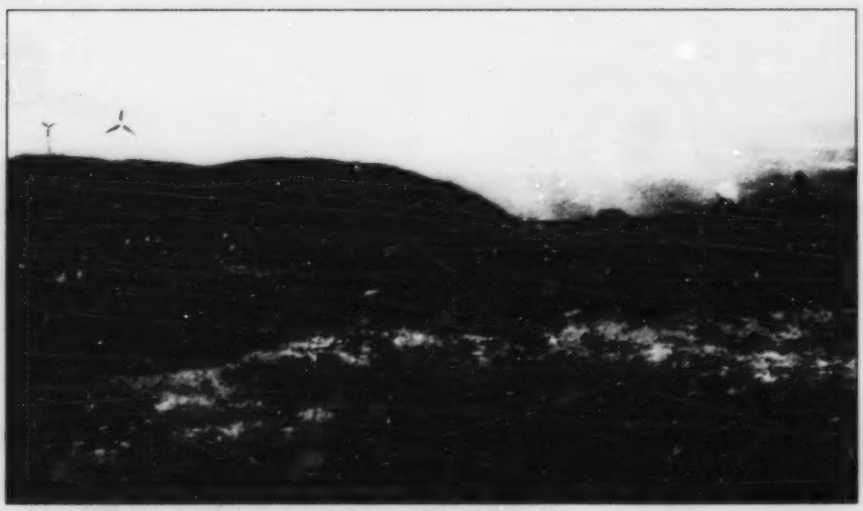
Head west from the larger wind turbine and descend the hill along the first gully. You'll join a cat-trail cut during the 1991 forest fire. At the bottom of this trail is a meadow-like valley between the hills.

Bear left across the meadow and look for the track leading up the opposite slope to the ridge top. Avoid bushwhacking as this is a fragile environment. Once on the ridge, note where the trail is so you can be sure to find it upon your return.

Heavy boulders carried by the flowing ice were left when the ice melted and fine material eroded away.

By continuing west along the ridge top, you will eventually reach the top of Sumanik, passing wind monitoring equipment along the way. There are many boulders scattered around so be careful of your footing. From the top of Sumanik, you will have wonderful views, including into the Ibex Valley.

Note: Hiking straight across the valley to Sumanik may look more direct but heavy brush and tough going will add many more hours to your hiking time.



Looking back towards Haeckel Hill from the ridge on Mount Sumanik.

Wind power & the turbines

"Wind is totally benign and it's totally renewable. You just wait until the wind blows. You're not burning any fossil fuels and creating carbon dioxide. You're not damming up a river."

Jack Cable, former president, Yukon Energy

Yukon Energy's two wind turbine electrical generators that sit atop Haeckel Hill are a spectacular sight. The Bonus 150 kW, the smaller of the two, was erected in July, 1993 and the larger turbine, the Vestas V47-660 kW, was installed in September 2000.

Yukon wind pioneers

After a number of disappointing trials in the 1980s, the National Research Council (NRC) and the Yukon government almost wrote off wind generation in the Yukon. However, wind got a second chance from two long-time Yukon residents, Dr. Doug Craig, a geological engineer, and his friend, Jack Cable, a chemical engineer, lawyer and the current Yukon commissioner.

Thinking that wind potential might be better at higher elevations, Craig dug through records of Whitehorse weather balloon information from Environment Canada. He observed that good wind velocities did exist at higher altitudes. Encouraged, Craig and Cable set up the Boreal Alternate Energy Centre in 1990 to explore energy options.

Boreal rounded up two NRC wind monitoring instruments left in the north from previous studies. With a truck loaned by The Yukon Electrical Company Ltd. and $1,500 that Yukon Energy Corporation contributed, Boreal was able to erect its first tower at the 1,430-metre level on Haeckel Hill.

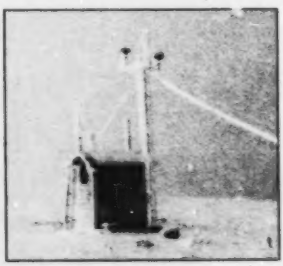
Despite instrument icing problems, Boreal demonstrated that Haeckel Hill experienced 10 times more wind energy than the Whitehorse airport.

In 1991 and 1992, instruments on Mount Sumanik, at 1,550 metres,

WIND MONITORING records wind speed, direction and temperature to assess the potential for wind generation. Sites for wind monitoring are chosen because of local knowledge of high wind regime and because of their proximity to a powerline or to a house that is off the electrical grid. It is important to monitor a site for its wind energy potential for at least a one-year period. Analyzing the wind data helps determine the economic feasibility of installing a wind turbine.

There are currently wind monitoring programs on Haeckel Hill and Mount Sumanik, along the Fish Lake Road, in Faro, Stewart Crossing, Carcross, and by Lake Laberge, Kluane Lake and Fox Lake.

Collapsed tower, Flat Mountain, 1991.



Rime ice on monitoring equipment on Haeckel Hill, 1994. Only heated instruments stay clear of ice.

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Rime ice

"Rime icing is a white frost-like build-up that you see on branches and trees around open water and occurs whenever there's a cloud contacting a mountain or ridge.

"Any solid object accumulates ice which 'grows' into the wind. Trees become ice domes, towers become ice posts, power lines grow to six or eight inches in diameter, and chainlink fences become solid walls."

John Maissan, Director, Technical Services, Yukon Energy

After years of monitoring on Yukon mountaintops, it has been found that rime ice is the single biggest obstacle to wind power generation. Annually, there are over 100 days of icing. Without ice prevention technology, this would lead to a 25% or more loss in energy production from the wind turbines.

and on nearby Flat Mountain, at 1,940 metres, revealed 15% and 30% wind energy increases, respectively.

By late 1992, Yukon Energy was negotiating with Bonus A/G of Denmark to purchase its first wind turbine. This would establish the possibilities for wind generation elsewhere in the Yukon.

Wind and weather

Generally, stronger winds are found on high hills and mountains almost anywhere in the Yukon. (Rime icing is present in many of these locations.)

The year-round prevailing wind in the Whitehorse area comes from southern directions with an occasional winter north wind. In the valley where Whitehorse lies, the wind tends to be oriented along the valley axis; that is, it will either come from the north-north-west or the south-south-east.

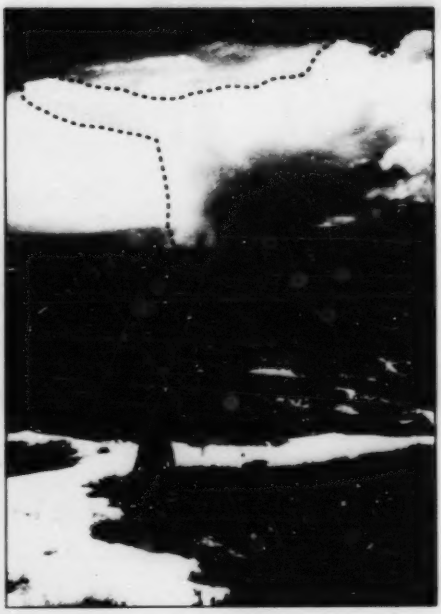
On Haeckel Hill, wind direction is more variable. South winds tend to range from the south-west to the south-east. In winter, there may be north winds.

In winter, too, the valleys often fill with heavy, cold, slow moving air while the stronger upper winds continue to howl at the mountaintops. This colder valley-bottom air phenomenon is known as an inversion — the temperature rises with elevation. On Haeckel Hill, it may be several degrees warmer and windier than in the valley. Often, when there are low clouds over Whitehorse, on top you will be in a clear, sunny day, looking down at a river of clouds below.

Landscape and climate

The Whitehorse area is located at the southwestern edge of the Yukon Plateau, a vast area of moderate elevation in the interior, characterized by hills, valleys and large rivers.

The Coast Mountains to the southwest feature steeper terrain and higher elevations. They act as a barrier to the moist air masses coming north from the Pacific Ocean, receiving significant precipitation and causing the climate in the interior (this area) to be much drier.



Anvil clouds, looking south.

Look for the anvil-like appearance of storm clouds as high-altitude, high-velocity winds race across lower clouds and flatten their tops. Watch the winds as they swirl around Grey Mountain forming clouds around the peak. These are common cloud features on warm summer days in this area.

People who live north of the Takhini River are familiar with a "weather divide" which makes that area much clearer and dryer than Whitehorse. From the top of Haeckel Hill, you may be able to see a distinct difference in the cloud-cover.

BLADE SPINNING Seen from downtown, if the blades appear to turn clockwise, the wind is from the south; if counter-clockwise, the wind is from the north. If the blades are not turning, there is insufficient wind, the equipment is down for maintenance or they have been automatically stopped because it is too windy!

The first turbine

Bonus 150 kW Mark III

The Bonus 150 kW wind turbine was erected at a cost of $800,000. The goal was to see if it was possible to use wind to generate electrical power in the Yukon's sub-arctic climate.

Specifications

- 150 kW capacity, 160 kW peak capacity; two speeds (30, 40 rpm), two generators.
- 30-metre hub height (tubular tower); three, two-piece fiberglass blades; 23.8-metre diameter blade circle; works in winds from 14 to 90 kilometres/hour.
- In high winds, the blade tips feather out of the wind, slowing the speed until the automatic brake stops it.
- Normal operating range to -30°C.

Special Yukon features

Because of the particular weather conditions under which the Bonus would be operating, modifications were made to the equipment.

These included a hinged 30-metre tower capable of installation without a large crane; low-temperature-tolerant steels; synthetic lubricants; six-inch heating strips for blade leading edges; and heating systems for the gearbox, generator, electronic cabinets and monitoring-instrument bearings.

Challenges and solutions

When blade icing occurred behind the heaters, wider heating strips and a

Rime ice

"Rime icing is a white frost-like build-up that you see on branches and trees around open water and occurs whenever there's a cloud contacting a mountain or ridge.

"Any solid object accumulates ice which 'grows' into the wind. Trees become ice domes, towers become ice posts, power lines grow to six or eight inches in diameter, and chainlink fences become solid walls."

John Maissan, Director, Technical Services, Yukon Energy

After years of monitoring on Yukon mountaintops, it has been found that rime ice is the single biggest obstacle to wind power generation. Annually, there are over 100 days of icing. Without ice prevention technology, this would lead to a 25% or more loss in energy production from the wind turbines.

and on nearby Flat Mountain, at 1,940 metres, revealed 15% and 30% wind energy increases, respectively.

By late 1992, Yukon Energy was negotiating with Bonus A/G of Denmark to purchase its first wind turbine. This would establish the possibilities for wind generation elsewhere in the Yukon.

Wind and weather

Generally, stronger winds are found on high hills and mountains almost anywhere in the Yukon. (Rime icing is present in many of these locations.)

The year-round prevailing wind in the Whitehorse area comes from southern directions with an occasional winter north wind. In the valley where Whitehorse lies, the wind tends to be oriented along the valley axis; that is, it will either come from the north-north-west or the south-south-east.

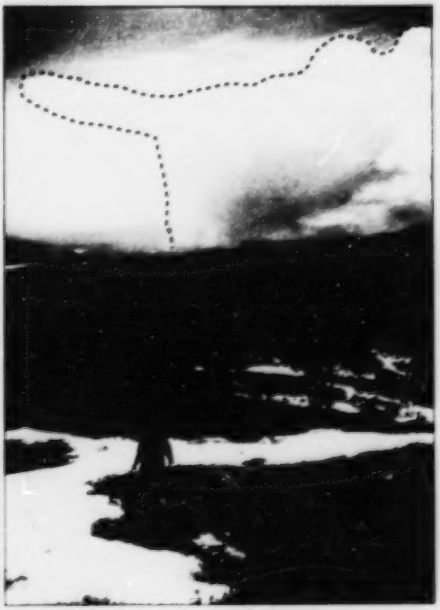
On Haeckel Hill, wind direction is more variable. South winds tend to range from the south-west to the south-east. In winter, there may be north winds.

In winter, too, the valleys often fill with heavy, cold, slow moving air while the stronger upper winds continue to howl at the mountaintops. This colder valley-bottom air phenomenon is known as an inversion — the temperature rises with elevation. On Haeckel Hill, it may be several degrees warmer and windier than in the valley. Often, when there are low clouds over Whitehorse, on top you will be in a clear, sunny day, looking down at a river of clouds below.

Landscape and climate

The Whitehorse area is located at the southwestern edge of the Yukon Plateau, a vast area of moderate elevation in the interior, characterized by hills, valleys and large rivers.

The Coast Mountains to the southwest feature steeper terrain and higher elevations. They act as a barrier to the moist air masses coming north from the Pacific Ocean, receiving significant precipitation and causing the climate in the interior (this area) to be much drier.



Anvil clouds, looking south.

Look for the anvil-like appearance of storm clouds as high-altitude, high-velocity winds race across lower clouds and flatten their tops. Watch the winds as they swirl around Grey Mountain forming clouds around the peak. These are common cloud features on warm summer days in this area.

People who live north of the Takhini River are familiar with a "weather divide" which makes that area much clearer and dryer than Whitehorse. From the top of Haeckel Hill, you may be able to see a distinct difference in the cloud-cover.

BLADE SPINNING Seen from downtown, if the blades appear to turn clockwise, the wind is from the south; if counter-clockwise, the wind is from the north. If the blades are not turning, there is insufficient wind, the equipment is down for maintenance or they have been automatically stopped because it is too windy!

The first turbine

Bonus 150 kW Mark III

The Bonus 150 kW wind turbine was erected at a cost of $800,000. The goal was to see if it was possible to use wind to generate electrical power in the Yukon's sub-arctic climate.

Specifications

- 150 kW capacity, 160 kW peak capacity; two speeds (30, 40 rpm), two generators.
- 30-metre hub height (tubular tower); three, two-piece fiberglass blades; 23.8-metre diameter blade circle; works in winds from 14 to 90 kilometres/hour.
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When blade icing occurred behind the heaters, wider heating strips and a

special coating were installed to shed the ice and increase efficieney.

Icing on the overhead power lines caused outages so the lines were buried to eliminate the problem. When the heated bearing instruments iced up, fully heated instruments were installed. The two-section blades caused tip heater problems. Unfortunately, rime icing still causes efficieney losses.

On the leading edge

"The systems to maximize the actual power output in our adverse conditions — lower temperatures and rime icing — were very much leading edge and still are in terms of what's happening throughout the world.

"Just by doing what's good for us we've developed expertise in a niche market that is suitable for use anywhere in northern North America, Scandinavia or Siberia, for instance."

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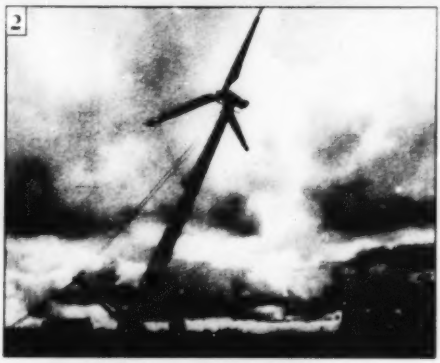
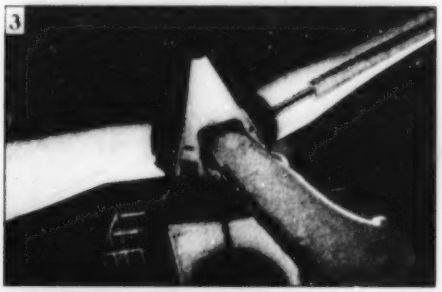


1, 2) Installation: A crane lifted the tower from the cradle high enough so that a hydraulic winch, secured by a Cat, could apply leverage through the gin poles to pull the tower vertical. 3) Heating strips. 4) Icing on the blades. 5) Applying black coating.

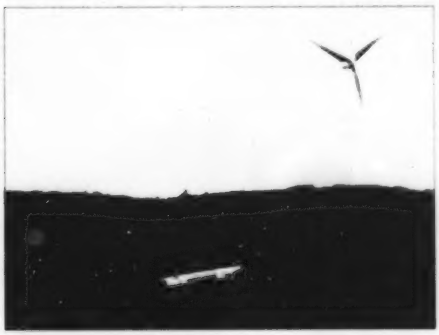


The second turbine

Vestas V47-660 kW

The Vestas V47-660 kW was erected on Haeckel Hill at a cost of $2,000,000. The goal for the Vestas is to test the commercial viability of wind power.

Features suited to Yukon conditions include a tubular tower for indoor climbing sheltered from the weather and one-piece, variable pitch wind blades to maximize power production.



The crane used to erect the new tower on its way up the newly widened road towards the Bonus.

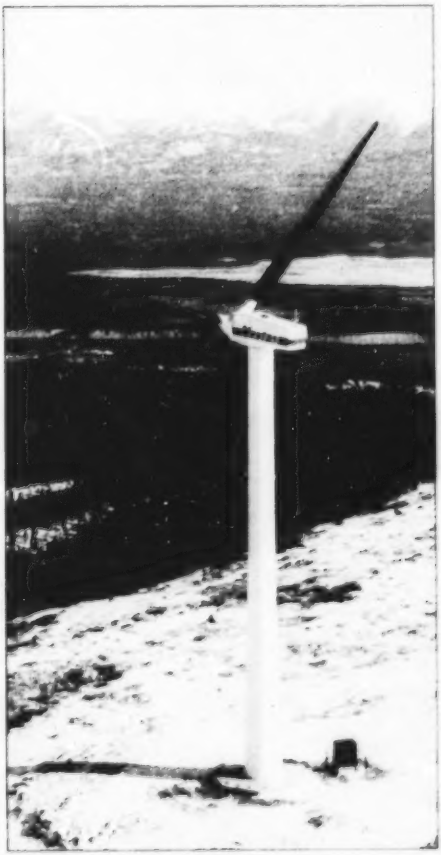
Specifications

- 660 kW peak capacity; single speed (28.5 rpm), single generator.
- 37-metre hub height; three fibreglass blades; 47-metre diameter blade circle; works in winds from 14 to 90 kilometres/hour.
- In high winds, the whole blade turns to feather out of the wind, slowing the speed until the automatic brake slows it to a stop.
- Normal operating range to -30°C; includes low temperature steels and other cold climate modifications.

"The Vestas tower was built in North Dakota. We had to bring up parts from all over the world — Denmark, the United States and places like Mexico. Roadwork was a big stage. The road up Haeckel Hill was not adequate to take a turbine the size of the Vestas. And getting a 180-tonne crane up there was no easy matter.

"We needed low-temp packages for the turbine to be able to work in the middle of winter when our best winds are. We actually had to put our own modifications on the blades for blade heating and anemometers and wind vanes. We couldn't use the standard Vestas anemometers."

Bill Haydock, Supervisor, Mechanical Engineering, Yukon Energy



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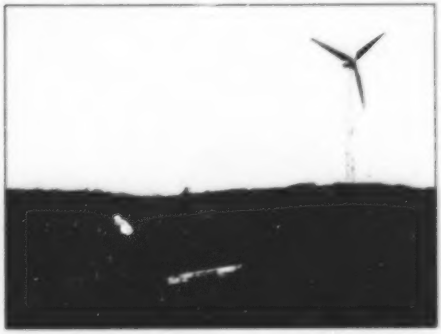

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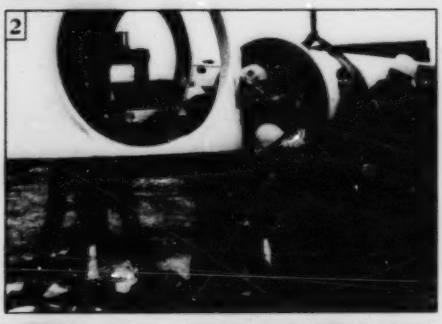

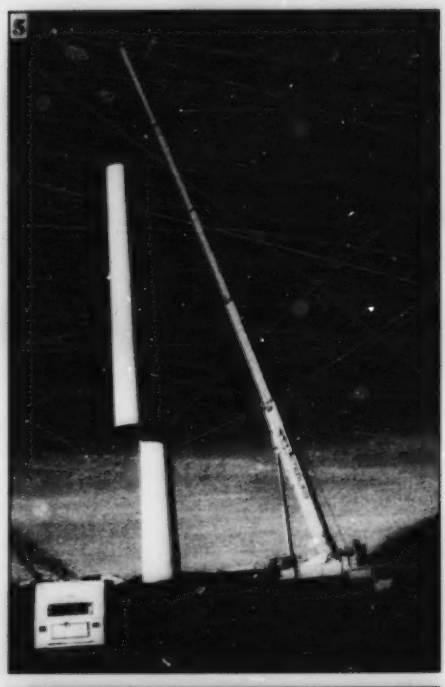

1) Tightening one of the many bolts holding the tower in place. 2) Joining a blade to the hub. 3) Looking up the ladder, inside the tower. 4, 6, 7) Mounting the blade/hub assembly to the nacelle. 5) Lining up the second part of the tower.

Green energy

Green power is electricity produced from renewable sources in an environmentally sustainable manner. The work on Haeckel Hill is laying the foundation for future wind projects, a known source of green energy.

The Vestas wind turbine will generate enough power for 130 homes yearly, compared to 23 homes for the Bonus. In one year, it will produce the same amount of power as 350,000 litres of diesel, the equivalent of reducing greenhouse gas emissions by about 1,000 metric tons.

The Vestas is still going through a tuning up stage to overcome rime icing. This phase took two to three years on the Bonus machine. Until rime icing effects can be overcome, commercial viability of wind power as a source of electricity is possible only in the longer term.

Studies show that wind lower down in valleys may be economic in combination with solar energy for small off-grid applications such as a lodge, but is not adequate for commercial generation. The one possible exception to this so far is Destruction Bay.

Ongoing studies into the feasibility of using wind to offset diesel generation in Old Crow and Destruction Bay are being done in cooperation with the Vuntut Gwitchin First Nation and the Kluane First Nation, respectively.

Look up!

The wind turbines normally produce power about 70% of the time during the windier, winter months, dropping to less than 50% in the calmer, summer months.

The Yukon's power grid now uses wind energy first, run of the river (Whitehorse Rapids) hydro second, reservoir storage (Aishihik Lake) third and diesel last.

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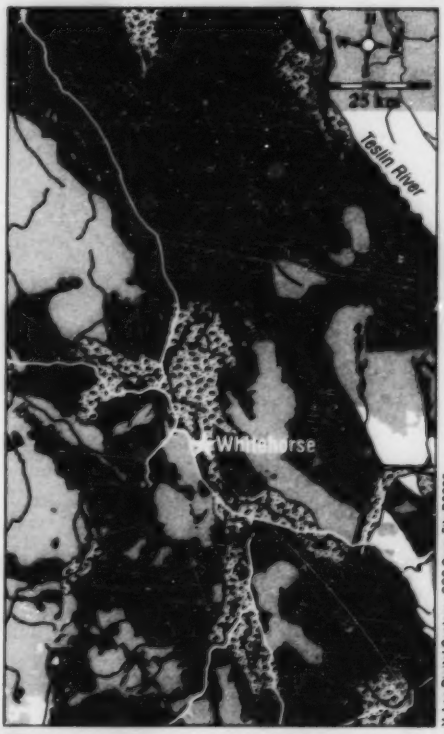
Rocks & glaciers: Keys to the landscape

The land before you has been shaped by complex and intense cycles of earth building processes that span more than 200 million years!

Rocks of the Whitehorse area were created by the action of volcanoes, and by the wearing down of these volcanic rocks through erosion. Other rocks resulted from melting of the earth's crust into magma (or molten rock). Following mountain building, all these rocks were eroded back down to the level that we see today. Recently (in geologic time), thick ice sheets repeatedly covered the landscape, both emphasizing pre-existing features and creating new ones. Erosion continues to happen today.

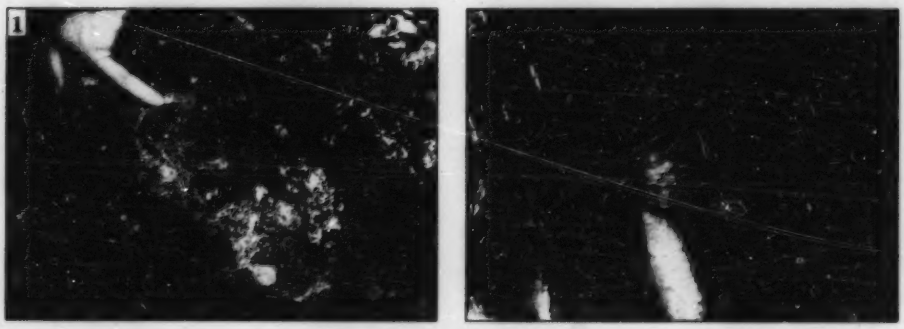


Yukon Digital Geology, GSC Open File D3826

- Stikinia-volcanic and sedimentary rocks, 200 million years old
- Granites and related volcanic rocks, 110 to 60 million years old
- Recent volcanic rocks, 8 million years old
- Thick glacial sediments, younger than 1 million years old
- Other rocks

Bedrock

Volcanic islands: Two hundred million years ago, the oldest rock (green on map), including those of Haeckel Hill itself, formed a chain of volcanic islands off the shore of western North America. As the volcanoes grew and the islands rose above the surrounding sea, rock fragments were washed away by erosion, and accumulated as sediments on the flanks of the islands and on



Some rocks are composed of rounded pieces of various pre-existing rocks (1). Others show a layering within the rock (2). Defined by changes in colour or in particle size, this layering was formed by the settling of particles of sand, silt and mud. The layering, also known as bedding, was near horizontal when the sediments were deposited.

Whitehorse Copper Belt

Copper deposits called "skarns" are formed when molten fluid-rich granite intrudes cold limestone. Ore, worth more than $500 million, was produced from 24 deposits stretching 30 kilometres, from the City of Whitehorse dump to the Carcross Road.

the sea floor. Limestone reefs grew in the warm ocean water. Limestone forms the light grey rock seen on Grey Mountain, Mount Sima, and in Rabbit's Foot Canyon. The volcanoes and their sediments formed an ancient continent that geologists call Stikinia Terrane.

Continental collision: Between 60 and 110 million years ago, tectonic forces caused Stikinia Terrane to collide with ancient North America. The resulting friction generated so much heat that the lower crust started to melt, forming magma that rose through the earth's crust. The magma cooled into light-coloured rock called granite (pink on map). Some of the peaks around Whitehorse, such as the tops of Mount Sumanik, Golden Horn, McIntyre and Granger, are underlain by granite. A large body of granite hosts the copper deposits of the Whitehorse Copper Belt, and is visible at the start of the Fish Lake Road.

Recent volcanism: The youngest rocks (brown on map) are lavas that flowed less than nine million years ago. Some of these form the basalt cliffs of Miles Canyon and provide the foundations for the Whitehorse Rapids hydro dam.

Glaciers: The legacy of ice

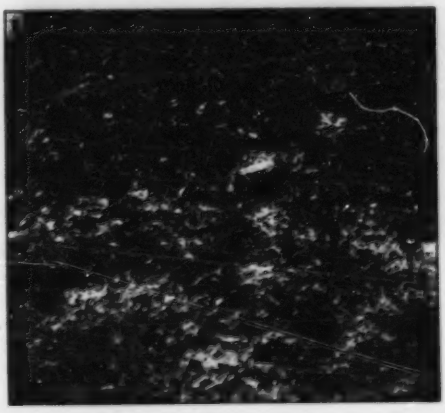
The area around Whitehorse is a mature landscape as the surface has been sculpted by erosion for a very long time. Valleys were carved by water; mountains were rounded by rain, wind, and the cycle of freezing and thawing. This area has been glaciated several times during the past three million years.

The ice sheets that covered this area were born in the high mountains near the coast. The rising land caused the accumulation of permanent snow and ice. With continued cooling and precipitation, the ice sheet thickened, grew and started to flow, eventually reaching lower elevations.

Even the nearby mountaintops were buried in the kilometres of ice. The great weight and slow movement of the ice sheet pulverized the underlying rock, and debris was carried downhill by the ice. As temperatures started to rise, ice melted and this debris was shed as deposits of silt, sand and gravel. A large glacial lake formed which eventually drained when it breached its own dam.

The debris left behind by melting ice is glacial till, a disorganized mixture of rock fragments ranging in size from clay to boulders (1). Till deposits can be observed in the road cuts above the fish farm and on the Fish Lake Road near the Alaska Highway.

Several glacial features can be observed from the top of Haeckel Hill. Lake Laberge is one of the remnants of the large glacial lake that filled the valley



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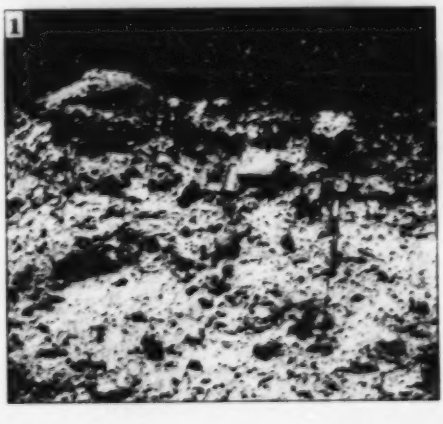
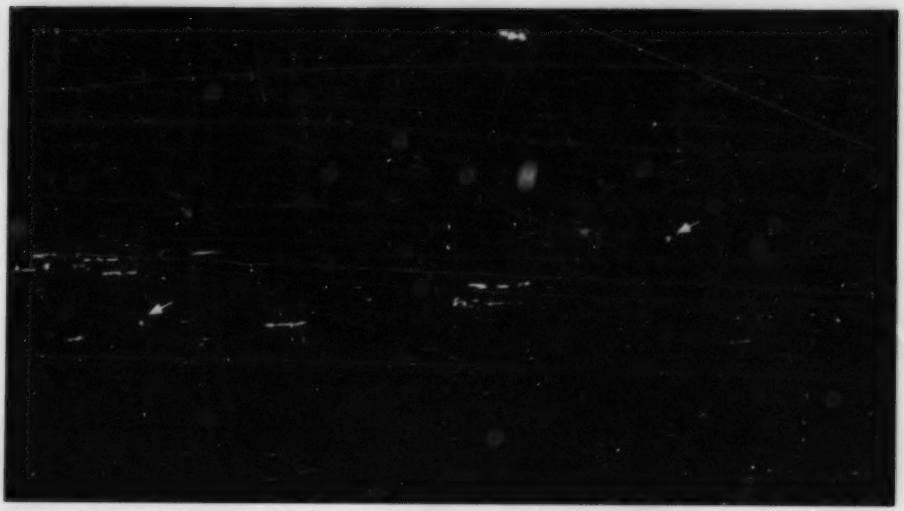




Linear features represent till that was deposited on the side of the glacier as it thinned (lateral moraines), as well as mark beach lines showing the shores of the later glacial lake. The clay cliffs and flat area around the airport were deposited as fine sediments at the bottom of the glacial lake. Arrows mark Whitehorse Rapids dam (right) and the airport control tower (left).

11,000 years ago. Steep-walled valleys, such as the one behind Copper Ridge and occupied by McIntyre Creek, were carved by melt water torrents flowing on the side of the glacier as it melted.

Recent glacial deposits (yellow cobble on map p.14) erode easily as they haven't been compacted into solid rock. They are sculpted into bluffs and gullies by modern streams and rivers.

Glacial features on Haeckel Hill include erratics, or boulders transported by ice for possibly very long distances. These get more rounded and polished the further they travel and can be made of rock types that do not occur locally, like the boulder of granite shown (1).

Other glacial features, called striations (2, diagonal lines), are caused by the gouging action of boulders that were carried at the base of the ice. When moving over bumpy terrain, the glaciers plucked rock from the lee side of irregularities, forming steep step-like surfaces that confirm a south to north ice flow (2, curved lines).

Evolution of a glacial landscape: from ice sheet to glacial lake

Twenty thousand years ago, thick ice covered all of the Whitehorse area, including the highest peaks. As temperatures warmed, the ice sheets started melting and eventually thinned enough that the deep, broad valleys underneath controlled the direction of ice movement (as indicated by arrows). The principal ice flow was from south to north, from higher to lower elevation, with the Carcross and Yukon River valleys acting as main pathways.

With continued warming and melting, the tops of the highest peaks (white areas on map 1) emerged through the thinning ice, forming nunataks or islands of rocks in a sea of ice.

Eventually, glaciers were confined to the main valleys. Meltwater ran off their sides or under them. In some places, meltwater was dammed by other glaciers.

Near the northern end of modern day Lake Laberge, a glacial lake started forming at the toe of the glacier, dammed by its own deposits of gravel, sand and clay left behind as the ice was melting and receding (2).

With continued melting, the ice front receded towards the south, and the glacial lake grew (3). When the ice melted in place for a long time (stagnant ice), it dumped thick deposits of sand and gravel. The lake eventually extended from the Haines Junction area all the way to Marsh Lake, forming the very large Glacial Lake Champagne (4). Fine silt settled at the bottom. This now forms the familiar clay cliffs and riverbanks cut by the Yukon and Takhini rivers.

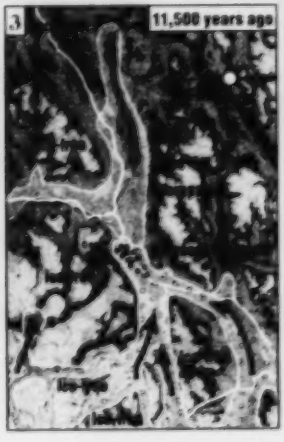
The glacial lake eventually breached its own dam and drained to form a glacial river, depositing sand that was later re-worked by the wind to form a network of wind-blown dunes preserved along the Yukon River and at the south end of Lake Laberge.

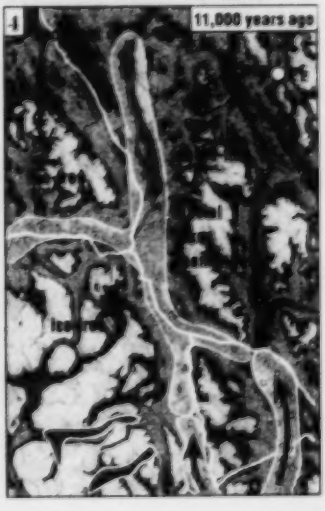
Imagine how this area would have looked to the first people here at the time when the land was newly emerged from the ice sheets.

Today, the modern day Yukon River continues to cut through the sediments in the on-going cycle of erosion and deposition.

Scale for maps 1, 4 — 25 km

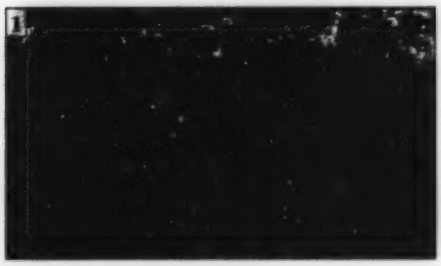
Scale for maps 2, 3 — 25 km

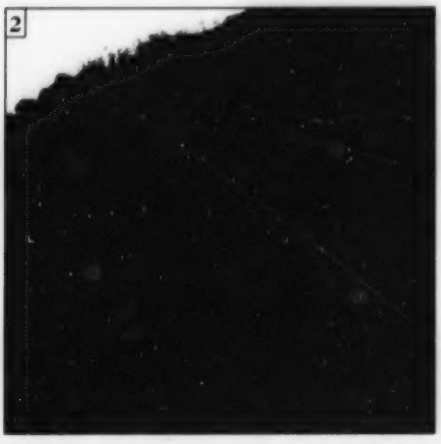




Erosion and landscape

The shape and orientation of Haeckel Hill and its cliffs and gullies are not random. They are controlled by planes of weakness in the rock. The rock wears off, or erodes, more easily along the bedding (or original layering) and along cracks and fractures called joints (1).





The top of Haeckel Hill is relatively flat because the surface rocks have eroded parallel to the near-horizontal bedding plane. In contrast, joints on Haeckel Hill are nearly vertical and erosion along them is favoured, creating the small cliffs and gullies observed on the summit. The combination of flat bedding plane and steep joint planes creates a step-like surface to Haeckel Hill (2).

Joints act as thin planes of weakness through which water can percolate. The freeze-thaw cycle causes ice in the thin cracks to expand and contract. This promotes fracturing and the breakdown of the rock (3). The hard minerals are converted by water to soft clay minerals. These provide nutrients to lichens, mosses and other vegetation (such as the fragrant cliff fern, 4) that grow along these joints and assist the microscopic chemical breakdown of the rock and the formation of soil. This process of breaking apart and wearing down the bedrock is called erosion. Notice large blocks which fall off cliff faces and roll further downhill, gradually getting smaller and smaller (5).

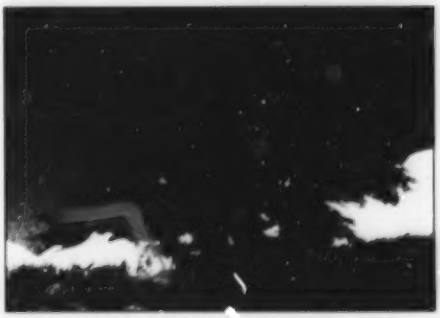
Vegetation at the top

As you approach the top of Haeckel Hill, you will notice that the forest gradually disappears and you are surrounded by spectacular views. This is where you cross the treeline into the subalpine zone.

It takes hardy plants to brave these harsh conditions. Here, trees are few and far between and many never grow taller than shrub height, often less than half a metre.

You may see coniferous species including lodgepole pine, spruce, subalpine fir and juniper. Notice how strong winter winds have scoured off the bark on some of the trunks where they poke above the snow, about a metre off the ground. Coniferous trees gain protection from these winds by growing in small tight clumps, at the same time catching more snow and moisture.

Shrubs such as willow, dwarf birch and Labrador tea are commonly found in depressions and gullies where there is more moisture.



Late snow clinging to a clump of spruce, known as "krumholtz" (crooked wood in German).

Fruit-bearing plants include lowbush cranberry, mossberry (or crowberry), and the occasional blueberry. A leathery texture on the leaves of many of the alpine plants is usually an adaptation to help them retain moisture.

Grasses, such as fescue and bluegrass, like southern exposures where the soil is drier. A few grass species were introduced during re-seeding in the disturbed area around the wind turbines.

One of the first views of a wind turbine (way over on the right) as you reach the treeline. Sumanik ridge is on the left.

Get down on your hands and knees

Flowers are conspicuously absent most of the year, but one search in early July revealed over 30 alpine species in bloom!

In many ways, the micro level holds the best treasures, such as the miniature ferns and mosses growing out of cracks in the rocks. Even if you don't know exactly what you are seeing, once you take a close look, you'll notice the structures are complex and varied, and often quite beautiful.

Would that be pine or spruce?

When you look across a forested valley, check the direction of the slope. Pine tends to grow on open, sunny south-facing slopes while spruce grows quite densely on darker, moister, north-facing slopes. Especially in the sunshine, spruce appears shadier, blue-green, whereas pine is brighter, more yellow-green.

Compared to spruce branches, the branches of a pine are more horizontal, even upward-turning. Spruce trees are sharp and pointy at the top and the branches tend to turn downwards.

Notice that lodgepole pine needles are long and flat, clustered in pairs, while spruce needles are single, short and three-sided with a white stripe down one side. (Fir needles are short, flat and shiny green.)

Adaptation

Alpine plants need to adapt to short growing seasons, freezing temperatures, snow at any time, strong winds, low nitrogen supply, low precipitation and little capacity of the soil to hold water. The plants cope by staying low to the ground, growing in gullies or depressions, developing leathery, small and/or hairy leaves, and growing in forms that can reduce wind effects and trap warm air on sunny days.

Lichens

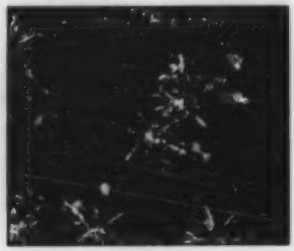
Lichens are abundant on rock surfaces and hidden in the undergrowth. Look for tiny greenish stems with red caps (*Cladonia*), or clumps of pale, smooth finger-like protrusions (*Dactylina arctica*), or the pale yellow-green forests of caribou lichen (*Cladina*).

Colonies of lichens growing on rocks in circles or random patches of colour may be hundreds or even thousands of years old. The growth rate is very slow, but in some cases quite predictable. Scientists can use this to determine the age of other objects and artifacts in the area. Because lichens tend to concentrate pollutants, they are often used as indicators of air quality.

Classifying lichens is a science unto itself. The three common growth forms include crustose (often found on rocks), foliose (leaf-like), and fruticose (with protruding stalks resembling tiny castles). Each type grows on different

Cranberry

Blueberry



Mossberry

You will see a lot of shrubs like these on Haeckel Hill. On the left is dwarf birch, standing about a metre high, with small, round, toothed shiny green leaves that go brilliantly red or orange in fall. On the right is diamond leaf willow (locally known as red willow) which grows about a metre tall and has bright yellow leaves in the autumn.

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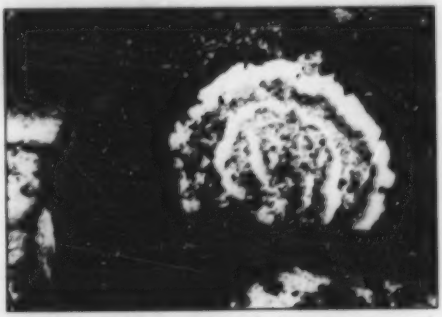
The grayish-green lichen with black mottling (a species of *Rhizocarpon*, or "map lichen") can grow to thousands of years old.

The orange lichen (usually a species of *Xanthoria*) often forms where the regular excrement of birds and small animals provides them with a source of nitrogen. When you see these orange lichen patches in locations on Haeckel Hill, this will become quite obvious.

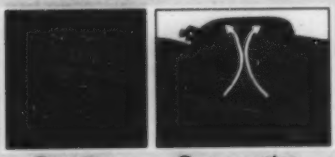


Rippled rockfrog or ring lichen grows on acidic rocks in well-lit locations and is fairly common in boreal forests.

PERMAFROST The effects of permafrost (the presence of a permanently frozen soil layer) and intense freeze-thaw cycles can be seen in places on Haeckel Hill.

The soil can develop patterns of various shapes called frost boils or polygonals. On flat areas, these appear as round, polygonal (straight-sided) or elongated areas of soil and rock fragments lined by vegetation. On slopes, these develop as more step-shaped elongated strips. Where these structures are well developed, fine soil is in the centre and coarser rocks line the edges.

These features occur because seasonally frozen ground contains water that expands when it first freezes. This expansion pushes material in the soil up. The larger rock fragments will have more ice under and around them and will be pushed up higher than the finer material. (You may notice this in your garden on a frosty morning.) With thawing, the larger fragments cannot fall back to their original position because of infilling of finer material, so they fall a bit to the side. Finer particles travel more easily than the coarser ones when freezing rates are low (when temperature drops slowly) and will move away from the coarse material, and freeze later. So, with numerous freeze-thaw cycles, soil material gets sorted according to size.



Top view *Cross-section*

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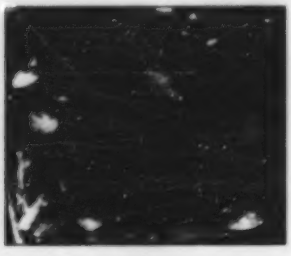

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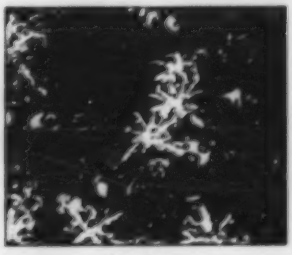

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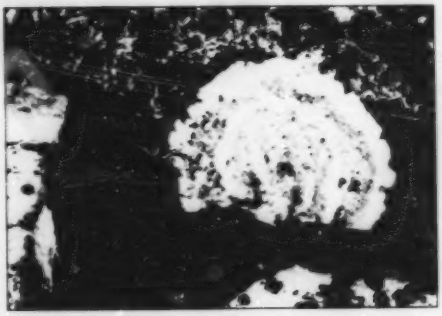

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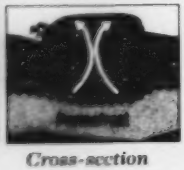

Cross-section

Wildlife to watch for

Although the bare subalpine conditions at the top of the hill do not offer suitable year-round habitat for large animals, the area is used by a variety of species, depending on seasonal conditions. New growth after the 1991 forest fire is an important factor influencing the diversity of animal and bird species now found here.

Mammals

Bears are seldom seen in the area, however, it is likely that a few still inhabit the vicinity. Both grizzly and black bears were frequent visitors to the nearby city landfill until 1995, when the City of Whitehorse erected the first electric fence to keep them out. On occasion, bears still visit local neighbourhoods in search of food.

Historically, this area offered good moose hunting for First Nations people. While Haeckel Hill has some important habitat features, such as food and low snow in early winter, moose are seldom found here now, likely because of its proximity to town.

Old growth spruce and fir forests offer ideal habitat for martens. Haeckel Hill is one area near Whitehorse where native martens reside. Their primary food source, the red-backed vole, is common in the forest and subalpine shrubs here.

Red squirrels are common in forested areas, but not in the open shrubs and rocks at the top of the hill. Red fox are sometimes seen hunting ptarmigan.

The rear end of a porcupine, as seen near the top of Haeckel Hill.

Birds

Birds soar in the windy environment on top of Haeckel. Watch for Bald Eagles, Golden Eagles, ravens and falcons in the updrafts and wind spirals. As you look out over the landfill area, you may see gatherings of ravens at play.

The Yukon and Takhini river valleys are important migration routes for many species of waterfowl. Spectacular flocks of Trumpeter and Tundra swans, geese and ducks pass in the spring and fall.

IDENTIFYING RAVEN, EAGLE AND HAWK Bald Eagles, twice the size of hawks or ravens, get their distinctive white head and tail after adulthood, sporting brown and white feathering for their first three years. Many hawks are dark above, and dark and light below. Ravens are all black, except in the glancing sunlight when they can gleam brilliant white. They have distinctive wedge-shaped tails while those of hawks and eagles are fan-shaped. Eagles' hooked beaks, like those of hawks, are ideal for tearing open salmon. The raven has a large, heavy, straight beak.

The forest vegetation of Haeckel Hill offers good habitat for grouse, ptarmigan and woodpeckers and a few species of water birds. In the subalpine forest you may find Townsend's Solitaire and perhaps Dusky Flycatcher. Golden Crowned Sparrow and Horned Larks are very vocal in this habitat.

Bird watching on Haeckel Hill

by Dennis Kuch

In the mid-1990s, I had the opportunity to spend some early morning hours on top of Haeckel Hill, helping bird biologist Dave Mossop with his study to determine the use of this high ridge by birds during spring migration. Wind generator towers can be deadly to birds, particularly on migration, when the guy lines and fast-moving vanes are lethal traps. The lineless towers and slow-moving vanes of the Haeckel generators may be less lethal, but ridges can be important migration corridors and how much this ridge was used was unknown.*

After a restless night spent in a shed cabled to the rocks, battered by ceaseless winds, I made an early morning start to the south edge of the ridge to watch for migrants by the light of the new day dawning over the valley.

From here, I had an extensive view of the Yukon River valley. I could follow the flight of swans for many kilometres, first catching sight of them as they left Marsh Lake at the edge of vision, then sighting the white spots of their shining bodies as they crested the spine of Grey Mountain below the microwave towers.

Over Riverdale and then the sewage lagoons they flew, bright white against the dark green pines, their trumpeting calls sometimes audible in the lulling winds. Five hundred metres above the river and 500 metres below my vantage point, they flew in front of me, bypassing the valley to my right. At the confluence of the Takhini and Yukon rivers, the Trumpeter Swans took a sharp left, leaving the Yukon River valley to follow the Takhini River, tracing a path to breeding grounds as old as the hills.

Blue Grouse.

That morning, few birds passed along the ridge itself, though a Spruce Grouse seemed to have taken up winter residence in the vicinity of the fire lookout.

Just as I was preparing to leave my perch, a smaller bird, sharp-winged, dark above and light below, winged rapidly by me, dropping below the ridge just as I brought my glasses up to get a closer look. A Peregrine Falcon? Perhaps.

As I waded through the snow drifts on my way back to the car, the grouse shuffled away from my path.

**Five years of study have shown that there appears to be no interference. Most migration routes are below the top of the hill, in the river valleys.*

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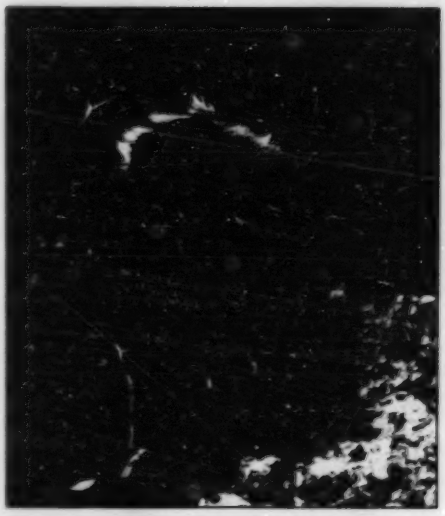

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People in the area

The location of Haeckel Hill makes it a geographical landmark in the history of First Nations people. The surrounding area is part of the traditional territory of the Kwanlin Dun and Ta'an Kwäch'än, two of the Yukon's First Nations.

Archaeologists, elders and students from these First Nations have been working to uncover the history of the people who lived here in times past. Many elders remember the locations of camps (▲) and trails (⋯) (1, 2). Listening to their stories and working with archaeologists at ancient sites provides new understanding of the presence of early people. The silent landscape seen from atop Haeckel Hill has a long cultural history.

Oral history, combined with stone tools, bone and antler pieces found at quarries and campsites, indicates that for thousands of years, First Nations people have been hunting, trapping, fishing and berry picking at camps and along seasonal trails in the area.

Kwanlin Dun

Archaeological digs of sites around Fish Lake, together with the oral histories of elders, show a long history of habitation.

Today's elders talk about life when they were growing up. For Kwanlin Dun families, late summer and fall found them gathering at camps at Fish Lake (Łu Zil Män). Here they set their fishing nets to catch trout and whitefish, snare abundant gophers and hunt for moose, caribou and sheep.

Some families stayed in the area over the winter and into spring, fishing through the ice, hunting moose and caribou in the mountains, and trapping beaver and muskrat.

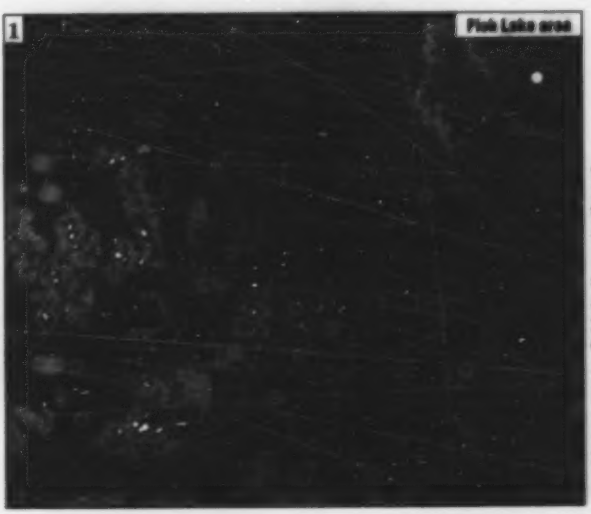
Today, the Fish Lake area continues to be home to Kwanlin Dun people. The landscape remains alive in the minds of the elders and through them, is shared with all of us.

Ta'an Kwäch'än

As with Kwanlin Dun, the Ta'an Kwäch'än way of life was based on fishing, hunting and trapping, with the people moving seasonally along well-established trails to harvest resources.

One of the main whitefish fishing camps was found at Shallow Bay (Män Tl'ät) at Lake Laberge. There, people made conical basket traps from willow poles, set them in the shallow water at the mouth of the creek, and then waded into the water to drive the fish into the traps.

The trails beside the Takhini River (Näku Chù) were an important route



adapted from Łu Zil Män Fish Lake, Uncovering the past

adapted from Ta'an Kwäch'än, People of the Lake

to the Ibex Valley, Kusawa Lake and beyond to the west. The Takhini Hot Springs was a site used for healing. Traces of an ancient hunting camp in a broad meadow opposite the Ibex River (Kākwäts'äneghru) have also been found.

Kohklux map

In 1869, at the request of a visiting American scientist, Kohklux, the chief of the Tlingit Chilkak, along with his two wives, drew a map of their inland trade route. This map provides a unique view of their trading trips into the interior, as far north as Fort Selkirk on the Yukon River.

The coastal Tlingit brought fish oils, dried seaweed and other sea products to trade for meats, hides, clothing, copper and furs. Trips were undertaken two or three times a year, taking about 30 days each way. Most travel was overland.

Their map provides three-dimensional views of the mountains and is scaled in days of travel rather than by distance.

Whitehorse Rapids

The Whitehorse Rapids, near what is now Riverdale, were caused by the 8.6-million-year-old lava that flowed from a flank of Golden Horn Mountain. These rapids once created favourable conditions for salmon, and therefore, the establishment of early fish camps at the rapids.

In the late 1800s, however, these long-established ways of life suddenly changed with the arrival of thousands of newcomers, intent on finding gold.

The rapids became a navigational obstacle for the stampeders using the river as a route to the Klondike. As a result, the town of Whitehorse and the riverboat and rail industries sprang up.

Today, the rapids are gone, covered over in 1958 when the flow of the Yukon River was changed and a hydro dam and powerhouse were built on the secure bed of the basalt.

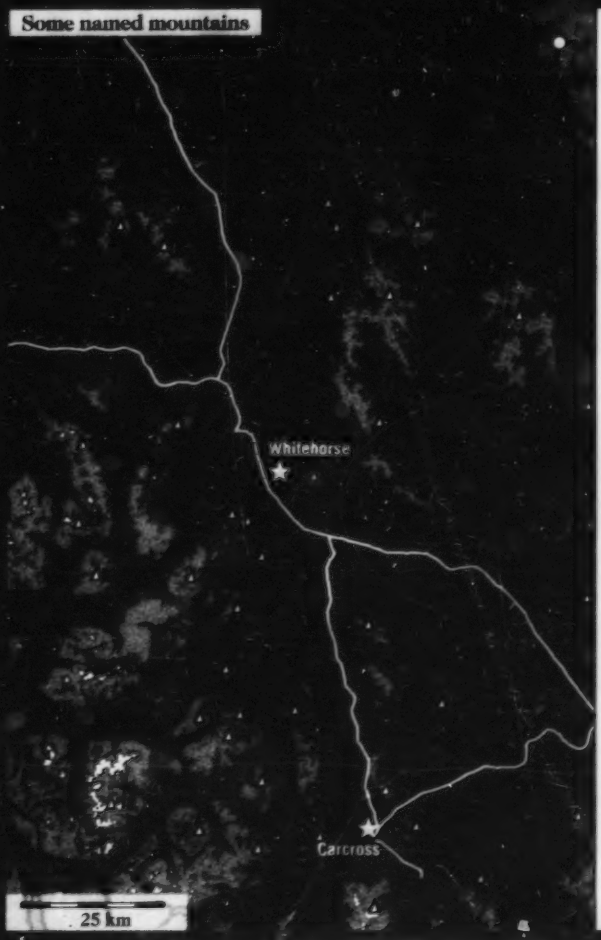
Getting around

In 1902, a winter road was built between Whitehorse and Dawson City, in part along ancient trails. Trips between the two towns took five to seven days, depending on the state of the rivers.

As part of a World War II defence system, the Alaska Highway was built in early 1942. It is visible to the south as far as Marsh Lake and to the north as it follows the Takhini River valley.

In the early 1950s, the road from Whitehorse to Mayo was finished, creating new ways to bring ore from northern mines to southern markets and ending the era of river travel. The road was extended to Dawson City in 1955 and is visible from Haeckel Hill as it heads north towards Lake Laberge.

As you gaze out on this vast land, much still wilderness, can you imagine what it might look like in 50 or 100 years, what human developments there will be, what changes nature will bring?



1. Haeckel Hill, 1433 m
2. Mount Sumanik, 1701 m
3. Mount McIntyre, 1597 m
4. Mount Sima, ~1190 m
5. Golden Horn Mountain, 1712 m
6. Mount Lorne, 2021 m
7. Mount Lansdowne, 1793 m
8. Caribou Mountain, 1972 m
9. Nares Mountain, 1778 m
10. Mount Gray, 1854 m
11. Stony Mountain, 1783 m
12. Mount Bell, 1958 m
13. Mount Skukum, 2382 m
14. Tally-Ho Mountain, 1783 m
15. Needle Mountain, 1729 m
16. Pugh Peak, 2080 m
17. Mount Perkins, 2034 m
18. Mount Hodnett, 1982 m
19. Twin Mountain, 1753 m
20. Double Mountain, 1761 m
21. Mount Granger, 2088 m
22. Ibex Mountain, 2107 m
23. Mount Arkell, 2209 m
24. Mount Ingram, 2148 m
25. Pilot Mountain, 2054 m
26. Flat Mountain, 1932 m
27. Lime Peak, 1616 m
28. Mount Laurier, 1779 m
29. Mount Slim, 1785 m
30. Grey Mountain, 1519 m
31. Cap Mountain, 1844 m
32. Joe Mountain, 2084 m
33. Teslin Mountain, 1953 m
34. Mount Byng, 2082 m
35. Mount M'Clintock, 1929 m
36. Mount Michie, 1779 m
37. Jubilee Mountain, 1813 m
38. Lime Mountain, 1593 m
39. Montana Mountain, 2205 m

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Phone numbers

Emergency services
Fire, police, ambulance, 911

Reporting forest fires
1-888-798-3473

Wildlife Viewing Program
667-8291

City of Whitehorse, Parks & Recreation
668-8323